METHOD OF CALIBRATING INFRASONIC HYDROPHONES

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TRANSLATION

ENGLISH TITLE: Method of Calibrating Infrasonic Hydrophones

FOREIGN TITLE: Sposob Graduirovki Infrazvukovykh Gidrofonov

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There exist known methods of calibrating infrasonic hydrophones in an open vessel with water at low frequencies, during which the hydrophone is brought into vertical sinusoidal oscillations and from the amplitude of its oscillations calculated infrasonic pressure in the medium is determined.

A special feature of the proposed method is that during its application the calibrated hydrophone is rigidly fixed in the cavity of the air-water resonator in neck of which vertical oscillations of the medium are created and from the amplitude of the free liquid surface oscillations sensitivity of hydrophones is determined as the ratio of the outlet stress to the sonic pressure acting at the hydrophone input. This increases accuracy and widens the measurements range on the side of high frequencies.

In order to eliminate the effect of the volume forces of inertia in the medium, level of the free oscillating liquid surface in the resonators neck is selected according to functional dependence of the measured output stresses in the hydrophone having the same sensitivity on two frequencies with the arbitrary meniscus level and frequency of the first resonance of the air-water resonator.

A device is shown in the sketch, putting into practice the described method.

The device contains a measuring chamber 1, connected by a flexible tube 2 with an open vessel 3, placed on a vibrating stand 4. Hydrophone 5 is rigidly fixed in the chamber and is connected to the input of the output stress meter 6. With the aid of vibrating stand vertical oscillations in the open vessel are produced with the amplitude h. Oscillations of the medium in the resonator neck determine the infrasonic pressure in the measuring chamber, acting upon the calibrated hydrophone. This pressure P is described by the equation

$P = \rho g h \cdot \chi \cdot \sin \omega t$, (1)

where χ is the modulus of the complex transfer coefficient (amplification) of the resonator;

ρ is the medium density;

g is the acceleration due to gravity;

ω is the radial frequency,

H is the column height of the oscillating liquid in vessel 3.

Hydrostatic pressure ρgh determined by the displacement of the free surface is, as may be seen from equation (1), in antiphase with the inertional pressure $\rho \omega^2 Hh$, determined by the oscillatory acceleration. Reduction of hydrostatic pressure conditioned by the volume forces of inertia is compensated by a corresponding increase of the sonic pressure, conditioned by the approach to the first resonator resonance. In order to achieve compensation of these dynamic factors it is necessary to select the column height H_k of oscillating liquid from the equation:

$$H_k = \frac{g}{\omega_0^2}, \qquad (2)$$

where ω_0 is the first resonance frequency of the system.

The optimal height H_k of oscillating liquid is found from the condition $H_k = H + \Delta H$, and ΔH is determined as the ratio of the output hydrophone stresses, having the same sensitivity, measured at two frequencies. The hydrophone's sensitivity is expressed by the ratio of the hydrophone output stress U, determined with the meter 6, to the pressure P according to formula:

$$E = U/P$$

Object of the Invention

1. A method of calibrating infrasonic hydrophones by way of varying hydrostatic pressure in a liquid, differing by the fact that for the purpose of increasing accuracy and widening the range of measurements on the side of high frequencies, the hydrophone is rigidly fixed in the cavity of an air-water resonator, in the neck of which vertical oscillations of the medium are generated, and from the amplitude of oscillations of the free liquid surface sensitivity of hydrophones is determined as the ratio of output stress to the sonic pressure acting at the hydrophone input.

2. Method according to point 1, is different by the fact that for the purpose of eliminating effects of the volume forces of inertia in the medium, level of the free surface of oscillating liquid in the resonator neck is selected according to the functional dependence of measured output stresses of the hydrophone, having the same sensitivity, on two frequencies at an arbitrary meniscus

level and a first resonance frequency of the air-water resonator.